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**US Army Corps of Engineers
Walla Walla District**

SPORT FISHERY USE AND VALUE ON LOWER SNAKE RIVER RESERVOIRS SUMMARY OF PHASE I STUDIES

Reservoir Sport Fishery During 1997

A creel survey of the sport fisheries in the four lower Snake River reservoirs was conducted from April through November 1997 as part of the Lower Snake River Feasibility Study. A combination of aerial flights and in-person interviews at access points throughout the nearly 140 mile reach was used to estimate angler effort, catch and harvest, catch and harvest rates, and various angler attributes. Interviewed anglers were also asked to participate in follow-up economic surveys that were used to determine the monetary worth of reservoir sport fishing.

During April and May, most fishing pressure occurred in backwater inlets and stocked mitigation ponds adjacent to the reservoirs. These side-channel areas received substantial pressure into June, but by the end of June, more anglers fished in the reservoirs. Angler counts peaked in late June and early July. Fishing pressure declined during August, and remained low until September 1 when steelhead harvest season opened. Angling pressure subsequently increased steadily from September through November, when the reservoir survey concluded. Occasional aerial flights during December through March observed angling at favored steelhead angling sites. By March the cycle began to repeat itself, with anglers returning to side-channel areas.

A total of 111,461 angler trips produced an estimated 489,215 hours of effort on the four reservoirs. Lower Granite Reservoir received the most fishing effort (220,605 hours), followed by Ice Harbor Reservoir (106,281 hours), Lower Monumental Reservoir (92,520 hours), and Little Goose Reservoir (69,809). Monthly angling use increased from 15,327 hours in April to 166,888 hours in November. Little Goose Reservoir

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received the most use during the spring and summer, whereas Lower Granite Reservoir experienced the most use from September through November. More than 63% of total effort was expended by boat anglers (308,546 hours) compared to shore anglers (180,669 hours). Ice Harbor Reservoir supported the highest proportion of use by shore anglers (63,350 hours), whereas Lower Granite Reservoir received the highest boat angling effort (181,544 hours).

Night angling occurred throughout the four reservoirs, although principally in Ice Harbor Reservoir in the summer months and Lower Granite Reservoir from mid-August through November. The focal point of night angling in Lower Granite Reservoir was the Snake River-Clearwater River confluence area.

Reservoir anglers caught an estimated 140,358 fish and harvested 83,066 (59.2%). Seasonally, catch and harvest were highest in July and lowest in October and November. The highest catch occurred in Lower Granite Reservoir (41,941 fish), whereas the highest harvest occurred in Ice Harbor Reservoir (29,128 fish). Shore anglers caught (58.5%) and harvested (63.5%) the majority of the fish.

The highest catch and harvest during April through June occurred in Little Goose Reservoir. During July and August, most fish caught and harvested were in Ice Harbor Reservoir. From September through November, the highest catch and harvest occurred in Lower Granite Reservoir and comprised approximately 42% of the system-wide harvest during those months. Overall, the harvest of fish during April through June was nearly equal to the harvest from July through November. Night anglers in Lower Granite Reservoir caught an estimated 1,475 fish and kept 853 from September through November. Night fishing yielded the most fish in October. Night angler catch and harvest during spring and summer was not estimated.

The catch of resident sport fish was dominated by three species. Crappie were the most abundant sport fish caught (34,072) and harvested (22,313) from the reservoir system during 1997. Most crappie were caught and harvested in Little Goose Reservoir. Smallmouth bass ranked second among fish caught overall (25,042 fish), although less than 30% (7,152) were harvested. Lower Granite Reservoir produced the highest smallmouth bass catch, but the highest harvest occurred in Lower Monumental Reservoir, where more than 71% of bass caught were kept. Anglers caught an estimated 18,156 channel catfish and harvested 73% (13,278) of those caught. Ice Harbor and Little Goose reservoirs yielded the majority of the catfish harvested.

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Among other resident species, yellow perch, sunfish, and northern pikeminnow were the more prominent. Most yellow perch and sunfish were caught in Ice Harbor Reservoir, whereas northern pikeminnow were caught principally in Lower Granite Reservoir. Most of the estimated catch (718) and all of the quantifiable harvest (40) of white sturgeon came from Little Goose Reservoir. Limited harvests of white sturgeon occurred in other reservoirs but were not included in the estimates.

Stocked rainbow trout provided a substantial spring and early summer sport fishery in mitigation ponds associated with Ice Harbor and Lower Granite reservoirs. Although the magnitude of the catch in these reservoirs was comparable, most of the harvest (5,672 of 9,005 trout) occurred at sites associated with Ice Harbor Reservoir.

An estimated 13,147 steelhead were caught and 9,541 harvested in the lower Snake River reservoirs during August through November. Most of the catch (8,429) and harvest (5,390) occurred in Lower Granite Reservoir, principally by boat anglers. In contrast, the bulk of the steelhead harvest in Lower Monumental and Ice Harbor reservoirs was by shore anglers. The sport fishery for steelhead in Little Goose Reservoir was comparatively poor (283 fish).

The estimated yield of sport fish in the lower Snake River reservoirs ranged from 7.60 kg/ha in Lower Granite Reservoir to 2.05 kg/ha in Little Goose Reservoir. Steelhead ranked first in the yield of each reservoir except Little Goose, where channel catfish provided the highest yield.

Little Goose Reservoir experienced the highest total catch/harvest rates (0.442/0.278 fish/angler hour). The lowest catch rate occurred in Lower Monumental Reservoir (0.119 fish/angler hour), whereas Lower Granite Reservoir experienced the lowest harvest rate (0.067 fish/angler hour). Total catch and harvest rates were typically highest during May or June and lowest in October or November. Catch and harvest rates were variable but generally similar for boat and shore anglers in each reservoir except Lower Granite, where shore anglers experienced considerably better success rates than boat anglers.

Steelhead was the most frequently sought species throughout the lower Snake River reservoirs during 1997. The proportion of anglers seeking steelhead from April through November exceeded 72%. Boat angling for steelhead occurred principally in Lower Granite Reservoir, whereas Ice Harbor and Lower Monumental reservoirs supported the most shore-oriented steelhead fishing. Other species pursued by Snake River reservoir anglers, in decreasing order of importance, were channel catfish, smallmouth bass, and

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stocked rainbow trout. Little Goose Reservoir supported the highest proportions of anglers seeking channel catfish and smallmouth bass. The highest proportion of anglers seeking crappie was in Lower Monumental Reservoir. Anglers pursuing stocked rainbow trout fished mostly at the mitigation ponds associated with Lower Granite and Ice Harbor reservoirs.

Seasonal preferences were observed on most reservoirs. Anglers fished for resident fishes and stocked rainbow trout mainly during April through August. However, on September 1 when steelhead harvest season opened on the Snake River, anglers directed most of their effort towards steelhead on all reservoirs except Little Goose. Anglers on Little Goose Reservoir continued to fish for resident fishes, principally channel catfish, during September, but by October anglers sought steelhead in Little Goose also.

Directed catch and harvest rates (rates calculated for only those anglers seeking that species) were generally highest for crappie, smallmouth bass, rainbow trout, and steelhead in Lower Granite Reservoir than other lower Snake River reservoirs. However, the harvest rates for smallmouth bass and steelhead were higher in Lower Monumental and/or Little Goose reservoirs. Boat anglers were generally more successful than shore anglers when seeking channel catfish, smallmouth bass, and white sturgeon, whereas shore anglers had higher success rates fishing for crappie and rainbow trout.

Among the resident or stocked fishes, directed catch and harvest rates were typically highest during May or June for crappie and rainbow trout, and during the summer months for channel catfish and smallmouth bass. Catch and harvest rates for steelhead tended to be highest in either October or November.

Anglers from 19 states and Canada in addition to the main states of Washington, Idaho, and Oregon fished on the lower Snake River reservoirs in 1997. The large majority of anglers at Ice Harbor and Lower Granite reservoirs originated from nearby population centers of the Tri-Cities and Walla Walla and Lewiston-Clarkston-Pullman-Spokane, respectively. Lower Monumental anglers resided principally in Walla Walla and vicinity or Tri-Cities. Anglers fishing Little Goose Reservoir were about equally represented by Walla Walla and Tri-Cities residents and

those from the Spokane-Moscow-Pullman areas. Participation in the reservoir fisheries by local anglers intensified during the steelhead season. The largest seasonal shift in anglers appeared to occur at Little Goose Reservoir in the fall, when anglers from the Spokane-Moscow-Pullman areas apparently shifted their destination to either Lower Granite or Lower Monumental reservoirs, presumably to fish for steelhead.

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Anglers visiting the lower Snake River reservoirs made mostly day trips. The highest proportion of day trips occurred in Ice Harbor and Lower Granite reservoirs. Little Goose and Lower Monumental reservoirs, both relatively isolated from population centers, received the most overnight visits. The use of paid lodging was notable only at Lower Granite Reservoir, and was almost exclusively associated with steelhead angling during the fall.

Steelhead angler characteristics and fishing methods varied among reservoirs. Shore fisheries were predominant in all reservoirs except Lower Granite, where 90% of steelhead anglers used boats. Similarly, baited lures were the primary gear used for steelhead fishing in all reservoirs except Lower Granite, where most anglers used unbaited lures. Among anglers in Lower Granite Reservoir, more anglers used an Idaho license (41.6%) than a Washington license (35.2%). Most of the remainder (23.1%) had purchased licenses from both states.

The temporal and spatial patterns of angler use in the lower Snake River reservoirs likely reflected the anglers' knowledge of where the best catch rates and best fishing conditions could be expected. Angling during April through June was focused in mitigation ponds and side-channel backwaters, where more than 70,000 catchable-sized rainbow trout were stocked, and more favorable angling conditions of higher water temperatures, shelter from the wind, less current velocity, and less runoff-borne debris occurred. By June, fishing conditions in the main channel portions of the reservoirs had improved, and most anglers utilized the main reservoirs during the summer months. Angler use of the main reservoirs intensified when steelhead season opened in September, but usage was focused at relatively discrete locations where anglers expected the best steelhead catch rates. These locations generally included tributary confluences (e.g., Clearwater and Tucannon rivers) and sites that provided access near fishway entrances and exits (e.g., shoreline above Ice Harbor Dam, Little Goose "wall").

The estimates of angler use are similar to the only known estimates of use for any reservoir on the lower Snake River. Previous estimates of angling effort in Little Goose Reservoir for a comparable fishing period ranged from 45,752 to 79,605 angler hours, similar to the estimate in 1997 (69,809 hours). The data indicated that sport angling in the lower Snake River reservoirs may be relatively static, and that anglers probably shift from Little Goose to adjacent reservoirs beginning in September to fish for steelhead.

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Channel catfish, crappie, and smallmouth bass largely supported the resident sport fishery, with channel catfish the most preferred. Channel catfish accounted for more than 75% of the yield (biomass) of resident fish in Ice Harbor Reservoir and was also particularly sought by boat anglers in Little Goose and Lower Monumental reservoirs. Smallmouth bass ranked second among resident fishes sought, and was the target of a substantial catch-and-release fishery in Lower Granite Reservoir. Although catch-and-release is common among smallmouth bass

fisheries throughout its range, the high proportion of released fish in Lower Granite Reservoir may be related to the small size of bass caught. In general, resident sport fishes have demonstrated slow growth and high mortality rates, a common feature of Northwest reservoirs, including those on the lower Snake River. Crappie fisheries spatially and temporally exist as found in earlier surveys.

The data suggest a shift in angler preference among the resident fishes towards channel catfish compared to that shortly after the impoundments were completed. Anglers probably target channel catfish due to their large average size, or perhaps increased abundance and distribution. The angler catch and harvest data generally corroborate the reported spatial distribution and abundance surveys of resident fishes in the lower Snake River reservoirs.

The most intensive angling effort in the Snake River reservoirs occurred during the September through November period when anglers targeted steelhead. Boat anglers expended more than 70% of the total effort during this time. Among the reservoirs, Lower Granite supported the bulk of boat angling effort, which was particularly focused at the Snake River-Clearwater River confluence area in Lewiston-Clarkston. Most shore angling for steelhead occurred at fishway exits or entrances in Ice Harbor and Lower Monumental reservoirs.

The current estimate of 192,000 angler hours for the September-November period in Lower Granite Reservoir indicates continued growth of the fishery in spite of fewer returning adult steelhead in recent years. A substantial night fishery directed at steelhead contributed nearly 9% of total effort for steelhead in Lower Granite Reservoir. Historical estimates of steelhead angling effort in the lower Snake River reservoirs are limited to 3 years of data for Lower Granite Reservoir from 1984 through 1986. Angling effort increased (68,000 to 116,000 angler hours) during the 3 years, likely in response to increased returns of hatchery fish from enhanced stocking.

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The patterns of angling use in the lower Snake River reservoirs seem to be consistent from year to year. Although the reservoir survey concluded on November 30, limited aerial observations of angler distribution continued throughout the reservoir system during December, 1997 through March, 1998. Angler use of favored steelhead fishing locations near the dams continued at a decreased intensity. By March, many anglers were again observed fishing in adjacent side ponds and backwater areas.

Willingness-to-Pay and Direct Expenditures

Two surveys were conducted on anglers fishing at the lower Snake River reservoirs for the purposes of: (1) measuring willingness-to-pay for recreational fishing trips and, (2) measuring expenditures by anglers. The surveys were conducted by a single mailing using a list of names and addresses collected from anglers at the reservoirs during May through October, 1997. The sport fishing demand survey resulted in 537 usable responses and the sport fisher spending survey received 411 usable responses. The response rate for both, rather complex, questionnaires was about 59 percent. The high response rate is thought to be a result of the excellent impression made by the initial on-site contacts, the return address for the questionnaire to the University of Idaho, a two dollar bill included as incentive, and the dedication to fishing by the anglers at the reservoirs.

The sport fishing demand analysis used a model that assumed anglers did not (or could not) give up earnings in exchange for more free time for fishing. This model requires extensive data on angler time and money constraints, time and money spent traveling to the reservoir fishing sites, and time and money spent during the fishing trip for a variety of possible activities. The travel cost demand model related fishing trips (from home to site) per year by groups of anglers (average about 20 trips per year) to the dollar costs of the trip, to the time costs of the trip, to the prices on substitute or complementary trip activities, and other independent variables. The dollar cost of the trip was based on reported travel distances from home to site times the average observed (in-sample) cost of \$0.19/mile for a car divided by the average party size (2.5) yielding 7.6 cents per mile per angler. The statistical demand model also accounted for differences in willingness-to-pay of anglers taking multideestination trips (40% of the sample) from those with only the reservoirs as their destination. Anglers for whom the reservoirs were an intervening opportunity along their "path" to a second recreation site had a higher demand for the reservoirs than did those who were not able to include additional nonreservoir sites in their trip.¹

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The primary objective of the demand analysis was to estimate willingness-to-pay per trip for fishing at the reservoirs. Consumer surplus (the amount by which total consumer willingness-to-pay exceeds the costs of production) was estimated at \$29.23 per person per trip. The average number of fishing trips per year from home to the lower Snake River reservoirs was 20.255 resulting in an average annual willingness-to-pay of \$592 per year. The total annual willingness-to-pay by anglers was estimated at nearly \$2 million dollars per year (\$1,956,560) after adjustment of the base value of \$1,675,952 for nonresponse bias.

The sport fisher spending survey collected detailed information on the types of purchases and the place the purchases occurred. Separate data were collected for the trip to the reservoirs, while on-site at the reservoirs, and on the trip home. Expenditure data for some 26 seller categories were obtained. The data allow measuring the average expenditure by type of purchase for various distances from the reservoirs. The name of the town nearest where each purchase occurred was collected allowing estimation of average purchases for each of the seller categories for a large number of towns.

Average group expenditures were \$229 per trip and the group size was 2.5 persons. Angler spending per person per trip was thus nearly \$92. Multiplying the per trip cost times the trips per year (20.255) resulted in annual spending of about \$1,855 for anglers traveling to the reservoirs. Total annual spending by anglers traveling to the reservoirs is found by multiplying the number of anglers (3,305) times annual spending per angler (\$1,855) or $3,305 \times \$1,855 = \$6,130,775$ per year.

Angler spending that occurred during the lower Snake River reservoir fishing trips excluded spending made while traveling to other fishing sites and excluded major purchases of boats or other gear, maintenance, storage, insurance and other non-trip related fishing costs. Angler trip expenditures includes non-fishing related purchases made during the trip.

¹The demand model was estimated using truncated negative binomial regression, which is appropriate for a dependent variable (fishing trips from home to site per year) that is always positive integers. The truncated Poisson regression technique was discarded because its assumption that the mean and variance of the dependent variable are equal was found to be incorrect for this data set.